

VIBRATIONS OF GUN BARRELS.¹

THE authors of this research on the vibrations of gun barrels were induced to make an experimental investigation of the behaviour of rifle barrels, in order to clear up certain difficulties connected with that which is known in ballistics as the *error of departure*. It had been noticed that in shooting with a rifle (whether held loosely, or firmly fixed), that the initial tangent to the trajectory—"die Anfangstangente der Flugbahn"—does not coincide, as would be expected, with the axis of the bore of the barrel, when produced, but is more or less inclined to it at a small angle; this is called the *angle of error of departure*. The authors, working with photo-chronographic methods, determined the movements of the muzzle end of a rifle in a vertical plane, and a vibrational movement of the barrel was detected, and recorded on a moving photographic plate, on the same plate; a trace from a tuning-fork of known period was also formed, so that the position of the muzzle was known at any instant. The rifle used was of the Mauser type M 71.

The collection of photo-chronographic records, twenty-eight in number, show the manner in which a rifle barrel

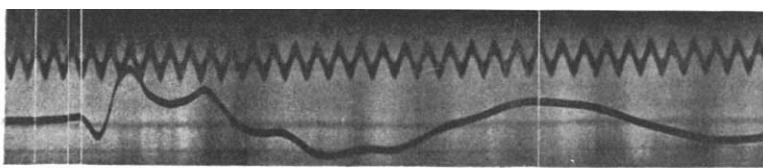


FIG. 1.



γ

FIG. 2.

Curves showing the vibrations of different parts of a gun barrel after firing. The spot on the bright line marked γ indicates the moment at which the shot left the barrel. Fig. 1 is the vibration curve of a point 1.5 cm. from the mouth, and Fig. 2 of a point 18.5 cm. from the mouth.

vibrates when subjected to the concussion due to an explosive. Figures 6, Plate I., and 7, Plate II., indicate a rapid initial vibration, apparently due to the beginning of the explosion. The records, as a whole, show how an error of departure may be produced. The photographs in some cases are not so clear and defined as those usually produced in physiological research; this is probably due to the beam of light having been cut off by an object of circular section, such as the wire used by the experimentalists. A thin metallic lamina, such as blackened aluminium foil, would have given sharper details. The authors show that the experimental results agree well with figures calculated on the assumption that the rifle barrel is a cylindrical tube.

There is much in the work of Messrs. Cranz and Koch which will be of value to the student of ballistics and to those who design military and other rifles. F. J. J-S.

NOTES.

THE Council of the Royal Society has adjudicated the medals for the current year as follows:—The Copley Medal to Lord Rayleigh, F.R.S., for his contributions to physical science; a Royal Medal to Prof. George Francis Fitzgerald, F.R.S., for his contributions to the advancement of physical science,

¹ "Untersuchungen über die Vibration des Gewehrlaufs." Von C. Cranz und K. R. Koch. Pp. 31. Six plates; 13 figures in letterpress. (München: 1899.)

especially in the domains of optics and electricity; a Royal Medal to Prof. William Carmichael McIntosh, F.R.S., for his important monograph on British marine zoology and on the fisheries industries, and on account of his work in establishing a Marine Biological Laboratory at St. Andrews; the Davy Medal to Mr. Edward Schunck, F.R.S., for his investigations on madder, indigo and chlorophyll. Her Majesty the Queen has graciously signified her approval of the award of the Royal Medals.

THE first congress of Russian electricians, organised by the Société Impériale Technique de Russie with the authority of the Ministers of the Interior and Finance, will be held at St. Petersburg on December 27, 1899 (January 8, 1900). The objects of the congress are the promotion of friendly intercourse between electricians, the exhibition of the most recent inventions in electricity and its applications to industry, the discussion of instruction in technical electricity, and other subjects which are concerned with the advancement of electrical science in Russia. The apparatus and machinery, plant, models and inventions, sent by electricians of any nationality, will be exhibited in the rooms of the Imperial Technical Society, Panteleimonskaja 2, St. Petersburg, to which address all communications should be forwarded. Objects intended for the exhibition will be admitted into Russia free of duty, under the condition that they are removed within a month of the close of the exhibition.

PROF. TYLOR writes to call attention to the remarkable activity of anthropological research of late years throughout Austria-Hungary. Students interested in such work may profit much by visiting several districts now of easy access, whether in quest of remains of the Hungarian Copper Age, the caves and burial-places of the Trieste district, the dug-out canoes of the Bosnian fishermen, or the dwindling survivals of ancient patriarchal-communal life in the zadrugas

of Croatia. As an example of the activity of the anthropological museums may be mentioned the descriptive catalogue, by Dr. Jankó, of the Biró Ethnographic Collection from New Guinea in the Hungarian National Museum at Buda-Pesth. The first part has been lately published, and is of so excellent quality that it is to be hoped that funds will be forthcoming to complete the work on the same scale.

MR. R. F. MUIRHEAD has been elected president of the Edinburgh Mathematical Society for the ensuing year.

THE American Geographical Society receives 1000 \AA under the will of the late Mr. C. P. Daly, for the foundation of a medal to be awarded for distinguished services to geography.

THE *Chemist and Druggist* announces that Prof. Moissan has been appointed director of the Laboratory of Practical Chemistry at the Paris Faculty of Sciences.

THOUGH the distance is not less than thirty miles, the sound of the firing at Ladysmith is said to be so plainly heard at Estcourt that the reports of heavy guns (supposed to be the two naval 4.7-inch guns, followed by the bursting of Lyddite shells) can be easily distinguished above those of the Boer 40-pounders and the smaller guns on both sides.

WE learn from *Science* that Mr. R. E. Snodgrass and Mr. A. H. Heller have just returned from a ten months' collecting

trip to the Galapagos Islands. The collections are large; birds, fish, and insects and spiders being represented by especially large numbers of specimens. The collections belong to Stanford University, under whose auspices the expedition was made.

As the gravels in the neighbourhood of Chelsea are very rich in rude flint-flakes and the like, many students of archeology and geology may be glad to know that a large vacant space at the corner of Cheyne Walk and Beaufort Street, Chelsea, is shortly to be built upon, and the excavations will probably go down into hitherto undisturbed soil. Mr. W. F. Sinclair calls our attention to the opportunity which the excavations will afford for collecting flint specimens.

By the death of Mr. William Pamplin, in the ninety-third year of his age, on August 9, English botanists have lost their *doyen*. Mr. Pamplin was an authority on British plants, and especially on their geographical distribution, in the first half of the present century. The "London Catalogue of British Plants" owed much to him. In the year 1827 he published a list of the rarer plants of Battersea and Clapham; and he was elected an Associate of the Linnean Society in 1830. Mr. Pamplin at one time carried on the business of a second-hand bookseller in London, but had lived for many years in great retirement near Bala in North Wales.

THE annual course of Christmas lectures, specially adapted for young people, at the Royal Institution, will this year be delivered by Mr. C. V. Boys, F.R.S. The subject will be "Fluids in Motion and at Rest." The lectures (which will be six in number) will commence on Thursday, December 28, at three o'clock. The remaining lectures will be delivered on December 30, and on January 2, 4, 6, and 9, 1900.

Science announces that Mr. O. F. Cook, of the Division of Botany, U.S. Department of Agriculture, left New York a few days ago for Puerto Rico to make a preliminary examination of the plant products of that island with reference to the introduction of new and useful tropical plants. Mr. Cook is accompanied by Mr. G. N. Collins, of the Department of Agriculture, as photographer, and by Mr. George P. Gall, who is sent by the Smithsonian Institution to collect material for the National Herbarium.

WE learn from the *Cape Times* that Mr. P. L. Sclater, F.R.S., who has lately returned from a visit to South Africa, attended a meeting of the South African Philosophical Society on September 17, and gave an address on the desirability of establishing a Zoological Garden in Capetown. Mr. Sclater showed that the important centres all over the world were taking measures to establish such institutions for instruction and recreation, and urged that Capetown, being the port and capital of what would shortly be an enormous empire, should not be behindhand in the matter. Mr. Sclater's proposals were discussed and well received, and a committee of the Society was appointed to consider the subject and report to a future meeting.

REFERRING to the death of Dr. Edward Orton, professor of geology in the Ohio State University, in the seventieth year of his age, the *American Journal of Science* remarks that while his labours have extended to all branches of geological science, his close watch of the exploitation of petroleum and natural gas, in Ohio and the neighbouring States of Pennsylvania and Indiana, has given him a place of pre-eminence as interpreter of these important geological products. In 1897 Dr. Orton was elected president of the Geological Society of America, and, as president of the American Association for the Advancement of Science, presided at the recent meeting of the Association, in Columbus, in August last. Prof. Orton was a man of broad

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culture and of influence outside his chosen science. He was for a time president of Antioch College, Yellow Springs, Ohio, and then became president of the Ohio Agricultural and Mechanical College, which has now become the State University. He resigned the presidency and became State geologist in 1882, which position he held up to the present year. Dr. Orton received the degree of Ph.D. from Hamilton College in 1848, and LL.D. from Ohio State University in 1881.

AT the opening meeting of the new session of the Royal Geographical Society on Monday, the president announced that, including the Government grant, the funds at the disposal of the joint committee on Antarctic exploration amounted to 90,000*l.*, but he recalled the fact that the grant which had been promised was made dependent upon another 5000*l.* being raised from other sources. A valuable paper, illustrated by many striking photographs, was read by Mr. W. Rickmer Rickmers, on a journey in the Eastern provinces of Bokhara, with his wife and Dr. von Kraft, now of the Geological Survey of India. Mr. Rickmers established a permanent camp on a tributary of the Yakh-su river, with the object of studying the wonderful mountain system of the "conglomerates" of East Bokhara. The "conglomerates" cover an area of 800 square miles, disposed in a long strip between the rivers Vaksh and Panj, with a strike from north-east to south-west. They show distinct stratification, and Dr. von Kraft ascribes them to the Tertiary period. The stones composing them are chiefly crystalline. The greatest thickness of the formation may be said to be at least 4000 feet. The population of the region is mainly dependent for its livelihood on the gold-washing industry. The yearly gold output of East Bokhara is variously estimated from 20,000*l.* to 30,000*l.*, but this is a mere trifle considering the potentialities of the alluvial deposits. The quantities extracted by the natives in the course of centuries have hardly encroached upon the store, and are as nothing compared with what Europeans could produce in a few years.

As appears from the Report of the Select Committee on the Destruction of Vermin, lately presented to the House of Assembly of the Cape, no less a sum than 27,084*l.* was spent in the various districts of the Colony in the year ending June 30, 1899, in rewards paid for the "destruction of vermin." This large expenditure not unnaturally excited the attention of the Legislative Assembly, who appointed a Select Committee to consider it. The Committee, after taking the evidence of many farmers, land-owners and other persons interested in the subject, have come to the conclusion that it is expedient for the agricultural interest (a predominant factor, it may be remarked, in Cape politics) that the system of giving rewards for the "destruction of vermin" should be continued, but that more care should be exercised in ascertaining that those who claim the rewards are properly entitled to them. The "vermin" in question appear from the evidence to be the Black-backed Jackal (*Canis mesomelas*), the Aard Wolf (*Proteles cristatus*), the Cape Baboon (*Papio porcarius*), and the so called "Lynx" or Roode Cat (*Felis caracal*), all of which are accused of ravaging the farmers' flocks, especially during the lambing season. The Aard Wolf, it is admitted, is not usually carnivorous, but is said to have developed of late years a noxious habit of tearing open the breeding ewes in order to get at the milk in their breasts.

A POSSIBLE substitute for india-rubber and gutta-percha was exhibited and described by Mr. W. F. Reid at the last meeting of the Society of Chemical Industry, under the name of "Velvril." The material appears to be suitable for machine-beltng—made by coating cotton canvas with it—waterproofing cloth or canvas, and as a varnish for paint, wood or metal; and so far as its mechanical and protective properties are

concerned, it compares favourably with gutta-percha. *The Electrician* is of the opinion that the material at present lacks the flexibility necessary to the core of a submarine cable, and also the strength and elasticity required for a golf ball. Perhaps with improved methods of manufacture these qualities can be given to "Velvral," but until then gutta-percha will hold its own as the most suitable substance for these two purposes.

A FEW years ago the phenomena of "Barisal Guns," and other similar noises, were discussed at some length in the columns of NATURE. A valuable contribution has recently been made to this interesting subject by Prof. A. Issel, in a paper published in the *Bollettino* of the Italian Seismological Society. The author's chief object is to describe the detonations which were heard at about the time of the Umbria-Marches earthquake of December 18, 1897. These detonations are quite distinct from the sound which generally accompanies an earthquake-shock. They are rather crashes, more or less prolonged, and resemble the boom of thunder or the report of heavy guns at a distance. Sometimes they are isolated ; at other times they occur in series, following one another at brief intervals. Generally they begin with a strong blow, which has very often a slightly metallic sound, and then gradually diminish in number and intensity until they cease, but there may be one or more renewals of activity. To many persons the crashes seemed to come from Monte Nerone, where the epicentre of the earthquake was situated. They are frequently heard at other times by the inhabitants of the middle Appennine region, and are known to them by the name of Bombio. Very often they occur in close connection with earthquakes, and they may be followed immediately by a slight shock or tremor ; they are also stronger and more numerous during epochs of maximum seismic activity. Prof. Issel correlates these crashes with those known in other places as Marinas, Mist-Poeffers, &c. ; and, as these phenomena are especially characteristic of seismic districts, he regards them for the most part as due to endogenous causes.

ELECTRICITY is rapidly gaining ground as a motive power for harbour and dock works and for traction on canals. In France haulage by electricity has been in use on some of the canals for several years, and, besides being found economical, has been of special value for working the boats through tunnels. The system is now to have a trial in this country, a portion of the Leeds and Liverpool Canal near Wigan being fitted for electric traction ; and it is anticipated that, besides other advantages, a saving in the cost of traction of 50 per cent, as compared with horse haulage will be effected. On the Dortmund and Ems Canal in Germany, recently opened for traffic, the cranes and other machinery at the terminal stations, and all the work at the locks connected with the opening and closing of the gates and sluices are to be operated from a central station, where electricity is to be provided by steam power. The haulage along the canal is to be effected by a small electric locomotive running along the tow-path, and obtaining its supply from trolley wires. On the Erie Canal one or more systems have already been tried with partial success. It is now reported that the storage battery system is to be introduced ; an electric traction engine will run along the tow-path and haul a canal boat filled with storage batteries of sufficient capacity to furnish current for the traction engine and the boats towed by it. The locks of the North Sea and Baltic Canal, and also the new lock of the Amsterdam Canal at Ymuiden, are both worked by electricity, which is found to have great advantages over hydraulic power in winter when sharp frosts prevail. In this country, at Southampton Docks and other places, cranes are in use worked by electricity.

A THESIS on "The Memory Image and its Qualitative Fidelity," reprinted from the *American Journal of Psychology*,

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has been received from Dr. I. Madison Bentley. The results of experiments carried on for the special investigation of the visual memory image and its fidelity to an original presentation have led to several conclusions of psychological interest. It appears that discs—grey and coloured—shown and remembered in daylight, tend to grow light in the visual memory, while grey discs shown in a dark chamber display a tendency in the visual image to grow dark during an unilluminated interval. These results indicate that the condition of the retina in respect to stimulation during the memory interval is important for the memory image. Illuminated and unilluminated intervals, where all other conditions are constant, are followed by different judgments with the same memory stimuli. It is therefore concluded that in all experiments with brightness and colour, where a time interval is involved, care should be taken to control the state of the visual organ. It is not improbable that a similar caution would apply to other sense memories. The results also show that memory is not to be regarded as a storehouse of perfectly conserved images, but that the most simple memories are continually exposed to change, and that it is, at times, only by the combination of various memorial resources that retention is made definite and exact.

THE intermittent treatment of sewage in bacteria coke-beds forms the subject of a second report presented to the London County Council by their chemist. Various investigations were carried out and are here recorded with the object of ascertaining the most effective method of constructing and working the coke-beds, and the data obtained form an interesting contribution to the literature, now considerable, daily accumulating on this method of sewage treatment.

THE reports of the malaria expedition in Italy under the direction of Prof. Koch receive adverse criticism at the hands of Dr. Grassi, writing in the *Atti dei Lincei*, viii. (2), 8. Among the points at issue it would appear that Koch, in the reports referred to, still admitted the possibility of malaria being propagated by *Culex pipiens*, a view long since abandoned by Grassi on circumstantial evidence, which he now summarises in detail. Much of the evidence which led Grassi to attribute the propagation of malaria to Anopheles and not to Culex has been given in previous papers in the same journal.

THE well-known experiment of the early popular text-books on "freezing and boiling water simultaneously" under the exhausted receiver of an air-pump being difficult to perform in practice, Mr. R. W. Quick describes in the *Physical Review* another mode of achieving a similar result. This is a continuation of the experiment commonly described under the heading "water boiled by cold," in which the tightly-corked flask containing the water and steam is cooled, first with iced water, and then with a mixture of solid carbon dioxide and ether, until ice forms as the water boils—or the flask bursts. As Mr. Quick remarks, there must not be sufficient residuum of air in the flask to keep the pressure above 0.46 cm. (the vapour pressure of ice at 0° C.), otherwise no amount of cooling would be effectual in causing boiling and freezing simultaneously.

A PAPER by Prof. Archibald Barr, on "Similar structures and machines," read before the Institution of Engineers and Ship-builders in Scotland, is appearing in the form of a series of illustrated articles in *Engineering*. The disproportionality between large and small structures required to ensure corresponding strength in supporting weight is illustrated by figures showing the difference in structure between the skeletons of large and small animals, and also by diagrams showing the Britannia and Forth Bridges reduced to the same span.

THE *Proceedings* of the annual meeting of the Indiana Academy of Science, held at Indianapolis at the end of December last, contains quite a number of mathematical papers, foremost

among which are Mr. D. A. Rothrock's papers on point invariants for the Lie groups of the plane, and on differential invariants derived from point invariants. To those interested in the geometry of the triangle, Mr. Robert Judson Aley's list of concurrent sets of three lines connected with the triangle will prove a most useful synopsis for purposes of reference; it enumerates eighty-four different concurrences. The same writer communicates a note on a new triangle and some of its properties; while Mr. C. E. Smith, of Indiana University, discusses the geometry of Simson's line. A linear relation between certain of Klein's X-functions and sigma functions of lower division value is given in a note by Mr. John A. Miller.

A FEW years ago Lussana discovered that the electric resistance of aqueous solutions presented certain anomalies in the neighbourhood of the temperature of maximum density, these anomalies being represented by a point of inflection in the curve expressing the relation between the resistance and the temperature. In view of the objections raised against Lussana's work and the intimate relation known to exist between the electric resistance of a fluid and its viscosity, it occurred to Dr. G. Pacher to examine whether any variations analogous to those found by Lussana existed in the coefficient of viscosity of water near the temperature of 4°C . The results of Dr. Pacher's experiments are described in a paper in the *Atti del R. Istituto Veneto*, Ixiii. (2), pp. 785-814. The coefficient of viscosity was found by observing the efflux of the liquid through a capillary tube, Poiseuille's law being assumed, and the temperature was maintained constant by immersing the tube in a water bath. From the viscosity its temperature-coefficient was calculated and represented graphically by a curve. The conclusions arrived at are as follows: (1) In the neighbourhood of 4° the viscosity of distilled water presents an anomaly indicated by a point of inflection in the curve connecting the viscosity with the temperature; (2) the temperature-coefficient of the viscosity presents a maximum followed by a minimum between the temperatures of 3° and 6° ; (3) given the relation between the temperature-coefficient of viscosity and that of electrical resistance, a similar anomaly may be expected to exist in the electrical resistance of distilled water; (4) Lussana's results thus receive indirect confirmation from the present investigation.

A POPULAR account of the possibilities and difficulties of aerial navigation, based upon the scientific experiments made by Langley, Lilienthal, Pilcher, Maxim and others, appears in the current number of the *Fortnightly Review*.

SIR JOHN EVANS's presidential address, on "The Antiquity of Man, with especial reference to the Stone Age in Egypt," delivered at the Birmingham and Midland Institute, has recently been published. It is a brightly written sketch of a vast subject; the more important approximate dates are given, which is a useful feature.

THOSE who are interested in Indian folk-lore must always keep an eye upon the *Journal* of the Asiatic Society of Bengal. The first part of the new volume of the Anthropological Section for this year contains a variety of interesting papers, amongst which may be noted one, by Mr. C. C. Mitra, on folk-lore about birds, and one, by Mr. C. A. Silberrad, on a rain-compelling ceremony which is performed by women.

A COPY of the Report and Transactions of the South-Eastern Union of Scientific Societies, containing an account of the proceedings at the fourth annual Congress held at Rochester in May last, has been received. The Union systematises scientific work among the different societies composing it, and in various ways promotes the interests of science. Next year's Congress will be held at Brighton early in June.

FROM Messrs. Williams and Norgate's very useful "Book Circular" (Scientific Series, No. 72), containing descriptive

notes on the contents of recent foreign publications, we obtain the following announcements as to forthcoming scientific works:—"Die Elemente der Entwicklungslehre des Menschen und der Wirbeltiere" is the title of a work by Prof. O. Hertwig, of Berlin, which will shortly be published.—M. Le Dantec, lecturer on embryology at the University of Paris, has written a work entitled "Lamarckiens et Darwiniens," which will be issued very shortly.—"Ueber Reduktionstheilung, Spindelbildung Centrosomen und Cilienglied im Pflanzenreiche" will be the subject of the sixth part of Prof. E. Strasburger's "Histologische Untersuchungen."—The first part of "Nouveaux éléments de botanique," by Prof. Louis Crié, of Rennes, will soon appear, and the second part will be published in the course of next year.—The fourth edition of Prof. Lapparent's "Traité de Géologie" will be issued in three parts. Of these, the first two will appear almost immediately, and the third will appear in January.

THE difficulty of preparing metallic caesium is well known. The metal has hitherto been obtained chiefly by the electrolysis of the cyanide mixed with barium cyanide, but the unsatisfactory character of this process is sufficiently shown by the price of the product, which is about twenty-eight shillings a gramme. It has been shown quite recently by Herren Graeffe and Eckhardt that caesium can be prepared easily and with an almost theoretical yield by the reduction of caesium carbonate by means of magnesium powder. The mixture is heated in an iron tube through which a slow current of hydrogen passes. The metal distils over, and is collected under melted paraffin. It has a silvery lustre with a slight yellow tint, and remains bright under paraffin. On exposure to air it oxidises rapidly, melts, and finally inflames. In its action on water it resembles potassium. A previous attempt by Winkler to prepare caesium by reducing the carbonate with magnesium failed, and led that chemist to doubt the statement of Beketoff that the reducibility of the alkaline carbonates increased with increasing atomic weight of the metal. Herren Graeffe and Eckhardt, however, confirm Beketoff's conclusion, and show that caesium is more easily reducible than rubidium, and rubidium than potassium.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albicularis*) from East Africa, presented by Lord Alexander Thynne; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. W. J. Beard; a Vervet Monkey (*Cercopithecus talandii*) from South Africa, a Viverrine Phalanger (*Pseudochirus cooki*) from Tasmania, an Agile Wallaby (*Macropus agilis*) from Australia, a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Rufous-necked Wallaby (*Macropus ruficollis*) from New South Wales, three Cardinal Eclectus (*Eclectus cardinalis*) from Amboyna, four Serrated Terrapins (*Chrysemys scripta*), three Prickly Trionyx (*Trionyx spinifer*), four Menobranchs (*Necturus maculatus*), an Amphiuma (*Amphiuma means*) from North America, three Mute Swans (*Cygnus olor*), European, deposited; a Black-backed Jackal (*Canis mesomelas*) from South Africa, two Brazilian Caracaras (*Polyborus brasiliensis*), an Anaconda (*Eunectes murinus*) from South America, purchased; a Spring-Bok (*Gazella eudore*) from South Africa, received in exchange; a Hog Deer (*Cervus porcinus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ANDROMEDES.—In respect to the reported observation of Biela's comet, no confirmation of which, however, is yet to hand, it will be well to keep careful watch on the character of the second November display. The maximum is timed to occur from the 23rd to the 27th, the approximate coordinates of the radiant being

R.A. = 1h. 40m.
Decl. = $+44^{\circ}$;